Date: 10/17/16

To: The DOH/EPA Red Hill Team

Subject: Actions that should be taken while the Red Hill Shaft is not pumping

The prolonged shutdown of the Red Hill Shaft provides a unique opportunity to investigate regional groundwater flow in the Moanalua/Red Hill/Halawa area. Below are suggested actions that should be taken to capitalize on this unique situation.

- 1. Take a round of synoptic water levels within the boundaries of the Red Hill Facility are 8 water level monitoring points (excluding RHMW07) that can be used to evaluate the contours of the water table. These wells cover rough 1 mile and are arranged roughly in the direction of groundwater flow depicted by Hunt (1996). If there is natural groundwater flow in this direction it should become immediately evident. The sampling pumps need to be removed from the intunnel wells to prevent interference with the cable of the Water Level Instrument. I believe that RHMW06 and RHMW07 have separate tubes for water level measurements so pump removal is not needed for these wells. However, the pump should be removed from RHMW04.
- 2. Conduct aquifer testing During the previous aquifer tests either pumping at the Halawa Shaft was not considered (TEC 2006 aquifer test), or there was pumping interference from the Red Hill Shaft (2015 USGS aquifer test). The shutdown of the Red Hill Shaft provides a unique opportunity to test the hydraulic connectivity between the Halawa Shaft and the Red Hill Facility. This would require instrumenting selected wells with pressure transducers. This would be followed by coordination with the Honolulu Board of Water Supply and ideally the USGS, to cycle the Halawa Shaft in a manner similar to the May 2015 aquifer test. The Red Hill Shaft should remain off during the cycling of the Halawa Shaft. The data collected by the Navy could be supplemented with continuous water level monitoring done by the HBWS, USGS, and DLNR. HBWS has wells in Moanalua and Halawa where they do continuous water level monitoring, I believe the USGS has an instrument in the Aiea Observation Well, and DLNR has an instrument in HDMW-2253-03. Depending on the level of collaboration, this network could be expanded to include wells such as TAMC-MW2 and Moanalua DH43. The continuous monitoring should continue in selected as the Red Hill shaft is brought back into full production and an extended period thereafter to allow the aquifer response to stabilize.
- 3. Conduct water quality testing the Navy has already indicated that they will increase the contaminant sampling frequency at the monitoring point in the Red Hill Shaft. Since RHMW02 is the well with the highest contaminant concentrations it seems logical the monitoring frequency at this well should also be increased. Downhole continuous monitoring of water quality can also be done. The specific conductivity of monitoring wells at the Red Hill Facility varies by over an order of magnitude. During the April, 2016 round of sampling the specific conductivity at RHMW01 was 348 μ s/cm, while OWDFMW1 had a specific conductivity of 3919 μ s/cm. Most major lines of well pressure transducers come with the option to also measure temperature and electrical conductivity (CTD transducers). Changes in electrical conductivity, especially if accompanied by changes in water level, could be a good indicator in changes in groundwater flow patterns. CTD transduces cost significantly more than the normal pressure/temperature transducers, but the data gained from monitoring this parameter at key wells would justify the added cost.

4. Collect and Interpret historical data — unfortunately most of the shutdown period for the Red Hill Shaft shutdown has already past. However, much important data has been collected during that period. Data collected include; HBWS, DLNR, and USGS data water level monitoring described above, water levels measured during monthly oil/water interface measurements (keeping in mind that interference between Water Level Instrument cable and the sampling pumps may bias some of the measurements), water level and electrical conductivity measurements taken during the quarterly sampling, regional pumping, and of course precipitation data since it can affect the other measurements. These data can be collected and correlated to evaluate the effect of the Red Hill Shaft shutdown vs. the effect of regional pumping and precipitation.

If you have any questions please drop an email or call me at (808)387-4869.

Thanks,

Bob Whittier